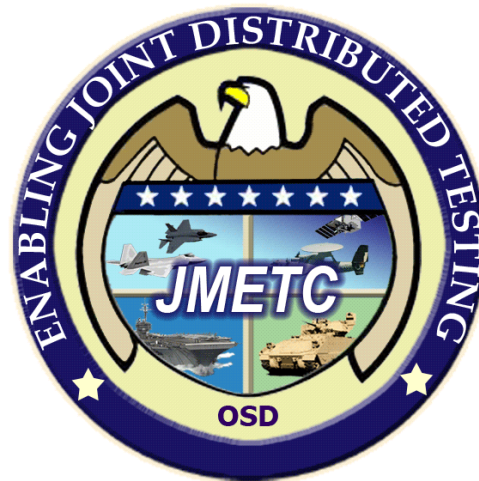


# Real Integrated Testing with Distributed Live, Virtual, and Constructive Simulations

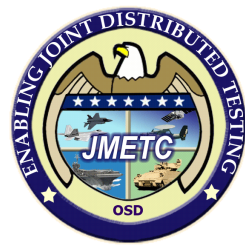


**Chip Ferguson**  
*Program Manager*  
*Joint Mission Environment Test Capability*

**Dr. Frank Gray and Dr. Marion Williams**  
*Institute for Defense Analyses*



# Real Integrated Testing versus ... ?



- **What is Integrated Testing?**

- Cohesive tests spanning all stages of testing
- NOT simply combining data from different test events
- NOT a replacement for dedicated Operational Testing

- **Why is it important?**

- Enables efficient testing
- Discovery in IOT&E is expensive
- But mostly ...

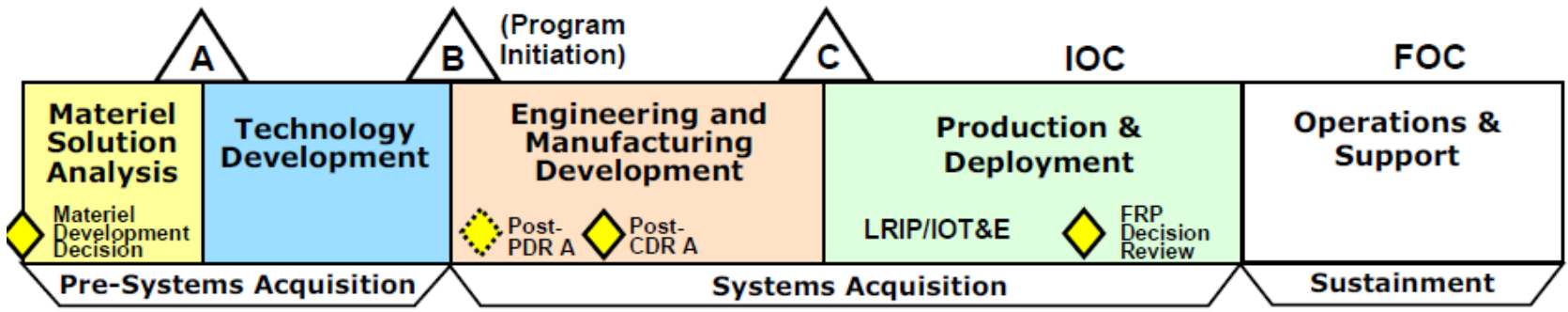
**... integrated development and operational testing can lead to better systems in the field**



# The LVC View of Integrated T&E

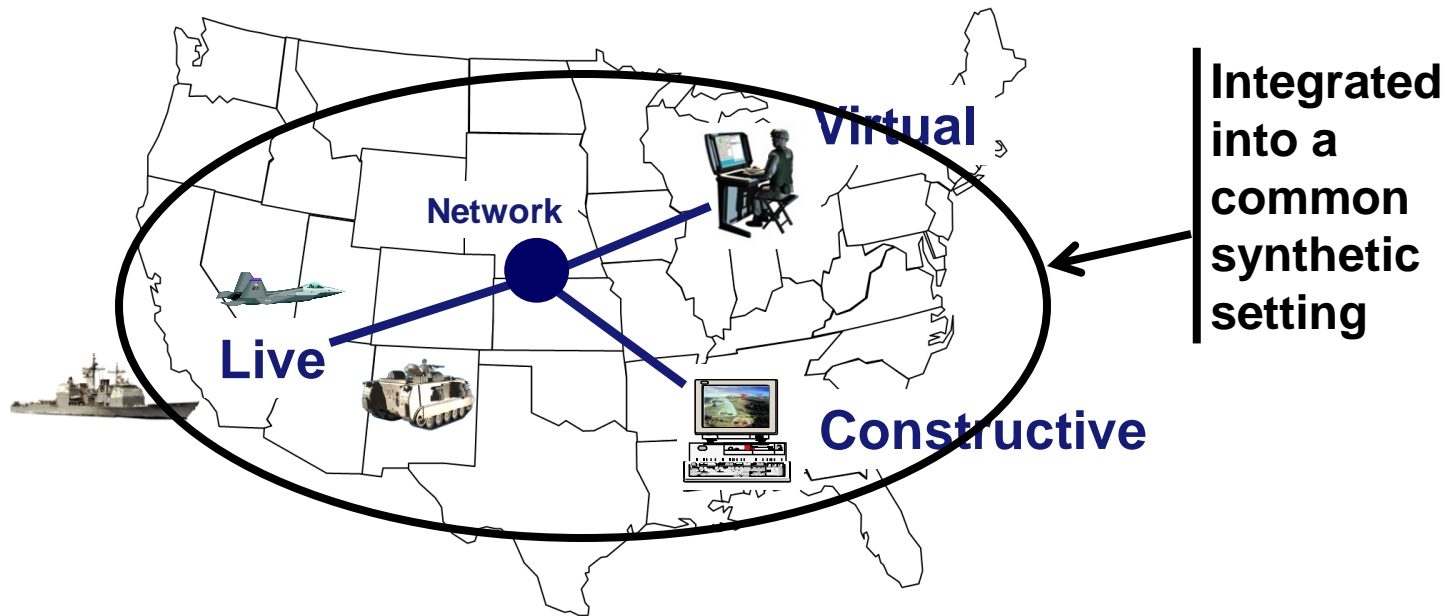
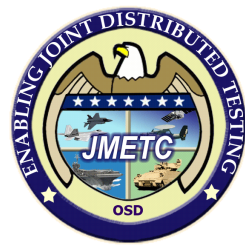


**Constructive → Virtual → Live prototypes → ...**





# What is LVC Testing?

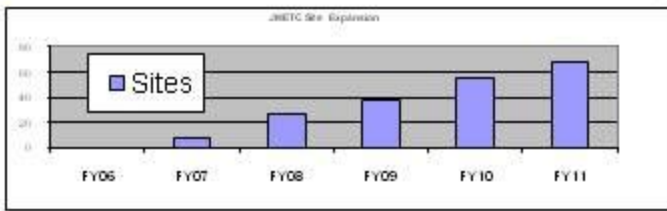
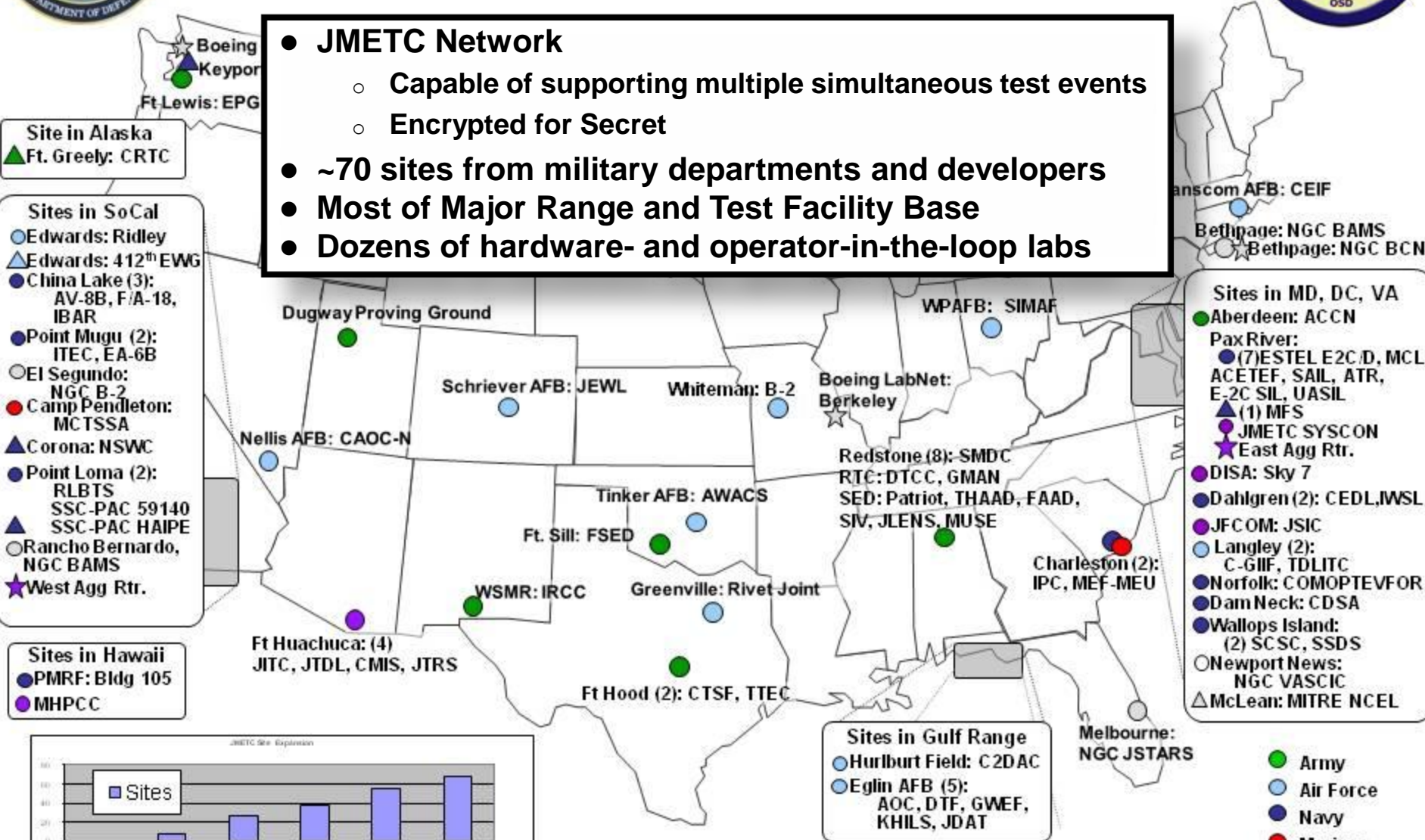


- L, V, or C systems under test
- Interactions among L, V, and C systems (an advantage and a challenge)
- L, V, or C systems operating together to accomplish military missions



# DoD LVC Test Resources

- **JMETC Network**
  - Capable of supporting multiple simultaneous test events
  - Encrypted for Secret
- ~70 sites from military departments and developers
- Most of Major Range and Test Facility Base
- Dozens of hardware- and operator-in-the-loop labs



As of 24 Jul 2011

- Army
- Air Force
- Navy
- Marines
- Joint
- Industry



# LVC Test Capability Development



- **History**

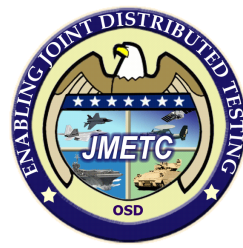
- **Joint Advanced Distributed Simulation project (1996)**
- **Testing in a Joint Environment roadmap (2004)**
- **U.S. Army Future Combat Systems work-ups (2005)**
- **Progressing from assessments to actual DT/OT (2005-present)**

- **Recent test methodology development**

- **Methods to determine if a test setup is good enough**
- **Build on accepted VV&A practices**
- **Use interoperability-like objectives**
- **Use AGILE Fire (Air-Ground Integration Layer Exploration) events**



# AGILE Fire Events 2009-present



- **Event Themes**

- Explore system interoperability requirements
- Execute operationally-realistic missions and tasks

- **Event Objectives**

- Set up distributed LVC tests for participants
- Orchestrate test conduct
- Manage data collection

- **Typical Systems Under Test**

- Multifunction Advanced Data Link (C)
- Tactical Air Control Party – Close Air Support System (L)
- Joint Air Ground Integration Cell (L)
- Joint and Combined Integration system (V)
- Dynamic Air Space Management system (V)
- Counter – Rocket Artillery and Mortar (C)
- Net-Enabled Weapon (C)



# Using AGILE Fire Events



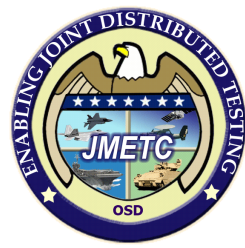
- **“VV&A Use Case”**
  - **Funded by Modeling & Simulation Coordination Office (MSCO)**
  - **Led by Air Force Simulation and Analysis Facility (SIMAF)**
  - **Generic networked-enabled weapon as system under test**
  - **Early integrated test with constructive test item**
- **Apply draft methods developed in 2009**
  - **Pragmatic approach**
  - **Focused on LVC for test and evaluation**
- **Update methods based on AGILE Fire findings**





# AGILE Fire Findings

## How to Determine if a LVC Setup is Good Enough



- **Traditional “VV&A” is not cost effective**
- **Build on things we do anyway**
  - Verification = integration spirals
  - Validation = dry runs
  - Accreditation = readiness to test
- **Three components of LVC goodness**
  - Pedigree of individual systems
  - Interactions among co-located systems
  - Interactions across the network
- ***Check runs* could help identify good LVC set-ups**
  - Runs under specified conditions with known results
  - Supports validity of runs under conditions with unknown results
  - Also useful for periodic calibrations during active testing



LVC 2004 - present

## Some (other) Things We've Observed



- **Customers were pre-acquisition or non-acquisition**
- **Real operators were injected into AoA studies**
- **V&C simulations were used to beef up tests of live C2**
- **Metrics mostly informal (no formal requirements)**
- **Business models were ad hoc**
- **No one could just “plug in” and test something**



# Current Status and Way Ahead



- **No enterprise-wide advocacy beyond JMETC**
  - Solid progress toward persistent network capabilities
  - Spotty progress toward a schedulable “LVC test range”
  - Solid progress toward SoS testing by individual programs
- **Real integrated testing in advocacy phase**
  - DOT&E and AT&L policy is relatively new
  - Recent integrated tests limited to late in development
- **What’s next?**
  - Continue maturing LVC to realism and rigor of live testing
  - Opportunities to move beyond less-than-real integrated testing



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# FY11 JMETC Events



Customer	Event	Event Dates*
JS J8/JIAMDO	Correlation/Decorrelation Interoperability Test (C/DIT) Integration Events (Continuous) OCONUS	October 2010 – September 2011
Navy	UAS in NAS Runs for Record	October 2010
Navy-led	InterTEC Spiral 3 Systems Acceptance Test	October - November 2010
Joint	JITC Joint Interoperability Tests JIT 11-1,2,3,4,5 (Continuous)	October 2010 – September 2011
Joint	Joint Surface Warfare JCTD (Continuous)	October 2010 – September 2011
JS J8/JIAMDO	Joint Sensor Integration	November 2010 – August 2011
Air Force	B1-B Fully Integrated Data Link Testing	November 2010
Joint, Air Force-led	AGILE Fire Phase III / JEFX 2011	December 2010 - February 2011
Navy	Broad Area Maritime Surveillance (BAMS) (Continuous)	January – September 2011
Joint	Joint Track Manager Capability (Continuous)	January – September 2011
Joint, Air Force-led	AGILE Fire Phase IV	May 2011 – August 2011
Joint, Army Systems	Unified Endeavor 11-3	May 2011 – June 2011
Joint	Combined Interoperability Validation Evaluation Tool (CIVET) Demonstration for Joint Strike Fighter	June 2011
Air Force	Air Force System Interoperability Test (Langley, Tinker, Greenville)	June 2011 – August 2011
Air Force	AGILE Fire Phase IV	June – August 2011
Navy-led	InterTEC Spiral 3, Release 2 Systems Acceptance Test	September - November 2011
<b>Discussions for Future Teaming</b>		
Gerald R. Ford Class (CVN-78)	Global Hawk	GATOR
Brigade Combat Team (BCT) Modernization	F-22 FY12 Testing Planned	Multi-Mission Maritime Aircraft (MMA)

\* Each event is normally preceded by 1-3 spirals: Connectivity Check, Integration, and Dry Run



# FY10 JMETC Events



Customer	Event	Record Event Dates*
Air Force	JEFX 10-1/Spirit Ice (B2 Data Link Test)	October – November 2009
Navy	BAMS LVC DE	October – December 2009
Air Force	Battlefield Airborne Comm. Node (BACN) JUON (DT/OT)	November 2009 to September 2010
Air Force	Agile Fire 10-2	January 2010
Air Force	JEFX 10-2/3	February/April 2010
Joint	Joint Surface Warfare JCTD	February to September 2010
JS J8/JIAMDO	Joint Sensor Integration	April to September 2010
Air Force	B1-B Fully Integrated Data Link Testing	April 2010
JFCOM J84/89 (TEST WEEK)	JCAS Distributed Test	June 2010
JIAMDO (Navy Lead)	Correlation/Decorrelation Interoperability Test (C/DIT) Integration Events (Continuous)	July to September 2010
Army (Lead)	UAS in the National Airspace	July to September 2010
Air Force	Agile Fire 10-3	August 2010
Joint	JITC Joint Interoperability Tests	JIT 10-3 & 11-1
Discussions for Future Teaming		
Gerald R. Ford Class (CVN-78)	Joint Strike Fighter (JSF)	JIAMDO/Joint Track Manager
Brigade Combat Team (BCT) Modernization	Multi-Function Adv Data Link (MADL)	Multi-Mission Maritime Aircraft (MMA)

\* Each event is normally preceded by 1-3 spirals: Connectivity Check, Integration, and Dry Run